

EVALUATION OF EXOTIC SUGARCANE VARIETIES FOR ADOPTION IN NIGERIA ECOLOGY

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Abstract

Eight exotic varieties and two hybrid clones were evaluated for adaptability to the different ecologies of Nigeria. They were planted in six locations using randomised block design in all the locations. The result revealed high performance by all the varieties for all the cane yield and yield components as well as sugar yield. This shows that the exotic varieties can be adopted in most of the ecologies in Nigeria. Two varieties showed high performance in the forest zones. BBZ921101 was found to have high fibre and high sugar yield which shows that it can be adapted for both energy and sugar yield.

INTRODUCTION

Sugarcane (*Saccharum officinarum*) is one of the world important cash crops and cultivated in both tropical and sub-tropical climates. Its production covers a wide range of ecologies and soil types. In Nigeria sugarcane is an important industrial cash crop (Olaoye, 2006) of high commercial interest (Wayagari *et al.*, 1999) and plays a significant role in food and income security of the country. The bulk of sugarcane produce in Nigeria are consumed raw for the sweetness of the juice but some of it are processed into varieties of products such as sugar, molasses, sweets and left-over leaves/stalks (Busari and Misari, 2007). It's also used for the production of alcohol used by pharmaceutical industry, ethanol, bagasse used for paper and chip board manufacturing and also burning sugar mills furnaces (Soomro *et al.*, 2006).

Nigeria is the largest consumer of sugar in Africa after South Africa. Unfortunately Nigeria produce less than 5% of its requirement, while importing more than 95% of the commodity. Lack of improved high yielding and adaptable sugarcane varieties has been identified as one of major problem of sugar production. Variety improvement through adoption of exotic varieties is one of the common means to improve yield. The goal of sugarcane breeding programmes is to increase sugar yield by increasing sugar production per area. According to Glaz (2000) sugarcane production can only be improved through the adaptation of promising varieties and technologies. Increased cane yield is a function of higher genetic potential of the variety (Nazir *et al.*, 1994). Oni 2015, reported that sugar industries in Nigeria rely more on cultivars brought in from overseas rather than those developed in Nigerian Research Institutes, for reason of inadequate information about the performance of the cultivars that were bred in the country. Assessment of performance, adaptation, of different sugarcane genotypes in different environments and evaluation of their traits is necessary before a variety is released for commercial cultivation.

However, variety improvement through adoption has its peculiar challenges. The wide variability of sugarcane genotypes in their growth, flowering, disease and pest resistance and yield performance among locations constitute such challenges. Variability is caused by the high sensitivity of sugarcane to environment due to its high polyploidy nature. Breeding and production activities involving sugarcane are thus regulated by the influence of genotype and environment on growth, yield components and yield. Determining the suitability of varieties

for different environments requires more than phenotypic evaluation in one plant cycle. Therefore evaluation of exotic varieties for suitability in different ecologies of Nigeria need at least a plant crop and two ratoon cycles for proper understanding of adaptability of the varieties to specific or many environments.

MATERIALS AND METHODS

Ten sugarcane clones (Eight exotic and two hybrids clones) were evaluated in six locations namely NCRI, Badeggi; University of Ilorin; Sunti, Bacita, Ikenne and Agenebode. The plant crop was established in all the locations in 2017 planting season. The plot size in all the locations was 5m x 6 rows with inter row spacing of 1.5m and replicated 3 times. Six (6) cane setts were planted per row. Data were collected on germination percent count, establishment percent count, stalk girth (cm), stalk length (cm), number of stalks per stool (no), number of millable stalks per plot (no), single stalk weight (kg), brix percent (field brix) and cane yield per plot (kg) later expressed in tonnes per hectare. Laboratory analysis of the juice from cane samples collected from Badeggi location was also done in the lab to determine the juice quality. The data collected were subjected to analysis of variance. Crop Stat (version 7.2) and Breeding view were used for data analysis. Soil samples were also collected from all the locations and analysed in our laboratory.

The test varieties are B 47419, B 881104, B 991114, BBZ 921101, BBZ 92653, BBZ 951034, BD 1354-17 (hybrid), BD 1388-31(hybrid), N 27 and SP81-3250. Sucrose recovery and sugar yield were calculated as shown below:

$$\text{Recovery sucrose \%} = \left[\text{pol} - \left(\frac{\text{brix-pol}}{2} \right) \right] \times \text{Juice factor}$$

$$\text{Juice factor} = 0.65$$

$$\text{Sugar yield (t/ha)} = \frac{\text{Cane yield (t/ha)} \times \text{Recovery sucrose (\%)}}{100}$$

RESULTS AND DISCUSSIONS

Significant differences were noted among the tested clones for stalk girth at Badeggi and Sunti (Table 1). BBZ 921101, BD 1354-17 and SP 81-3250 gave robust stalks compared to the check (B 47419) at Badeggi, while at Sunti BBZ 951034 gave the best stalk girth. The three other locations show non-significant differences for stalk girth among the tested clones. The result of this study is in conformity with the report of other researchers (Mohammed *et al.* 2019 and Rafiq *et al.*, 2006) who reported significant differences among sugarcane genotypes for stalk thickness.

Table 1: Mean values of stalk girth (cm) for sugarcane clones evaluated at different locations in Nigeria (2017)

VARIETIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENEBODE	AVERAGE
B 47419	2.4	2.0	2.4	1.5	2.5	1.7	2.1
B 881104	2.5	2.1	2.4	1.7	2.2	2.0	2.2
B 991114	2.5	2.0	2.5	1.7	2.4	1.6	2.1
BBZ 921101	2.8	1.8	2.3	1.4	2.2	2.9	2.2
BBZ 92653	2.4	1.9	2.3	1.7	2.4	1.9	2.1
BBZ 951034	2.5	2.4	2.5	1.7	2.2	1.8	2.2
BD 1354-17	2.7	1.9	2.4	1.7	2.3	1.8	2.1
BD 1388-31	2.6	2.3	2.3	1.9	2.2	2.1	2.2
N 27	2.6	2.1	2.7	1.7	2.1	1.7	2.2
SP 81-3250	2.7	2.2	2.9	1.5	2.3	1.6	2.2
	**	**	ns	ns	Ns	ns	
SE±	0.1	0.1	0.4	0.2	0.6	1.9	
CV	8.9	11.5	2.7	19.7	4.8	38.2	

Table 2 shows the mean performance characteristics of the clones for stalk length across locations. The clones showed better performance in stalk length in SuntI than other location. Stalk length was generally low at Agenebode location. At Badeggi location SP 81-3250 exhibited the best stalk length (254.7cm) which was significantly longer than the stalk length of B 47419, B 881104, BBZ 921101 and BBZ 951034. The variety B 991114 and BD 1354-17 perform better at Bacita in terms of stalk length which was significantly the same with the stalk length recorded for the check (B 47419). At Ikenne stalk length of 339.6 cm was recorded for N 27 which was significantly at par with the length (309.7cm) of BBZ 951034. B 881104 gave the shortest stalks among the studied clones in that environment. Significant difference in stalk length was observed among most genotypes. This is similar to result of Worku and Chinawong (2006) who reported significant differences in stalk length among sugarcane genotypes at Finchaa.

Table 2: Mean values of stalk length (cm) for sugarcane clones evaluated at different locations in Nigeria

VARIETIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENEBODE	AVERAGE
B 47419	199.7	400.0	256	174.7	291.3	61.9	230.6
B 881104	199.3	393.3	224.7	165.0	255.0	64.4	216.9
B 991114	215.7	433.3	268.8	160.0	277.7	54.1	234.9
BBZ 921101	197.7	436.7	215.4	182.0	270.0	57.2	226.5
BBZ 92653	243.4	496.7	210.9	133.3	265.7	59.1	234.9
BBZ 951034	196.9	516.7	245.8	186.3	309.7	54.6	251.7
BD 1354-17	226.1	463.3	268.5	178.0	303.7	54.8	241.9
BD 1388-31	229.1	450.0	220.7	146.7	297.0	55.7	233.2
N 27	226.0	490.0	245.0	166.0	339.6	50.9	252.9
SP 81-3250	254.7	540.0	252.6	187.3	298.0	54.7	264.6
SE±	17.8	19.4	4.5	15.1	11.6	4.6	
CV	14.1	7.3	3.2	15.6	6.9	14.1	

Table 3 shows the mean performance of the varieties for number of millable canes per plot across locations. Significant variations were noted in four locations (Badeggi, Sunt, Ilorin and Ikenne) for number of milleable stalks per plot. Highest number of milleable stalks (206.7cm) was recorded in BBZ 92653 and the least number was observed in the check (B47419) at Badeggi. BBZ 92653 also the highest number of Milleable stalks at Sunt. In Ikenne the Check (B 47419) entry possess highest number of milleable stalks. Across the locations B 47419 gave the highest (164cm) number of milleable stalks and B 99114 show the least milleable stalks per plot. The number of millable stalks per plot were generally low in Ilorin than other locations. This trait is one of the most important yield components and attentions should be paid to it when selecting for varieties that give high cane yield. This result is in accordance with the findings of Muhammad *et al.*, (2014) who recorded significant differences among sixteen newly selected sugarcane varieties in Pakistan.

Table 3: Mean values of milleable stalk per plot for sugarcane clones evaluated at different locations in Nigeria

VARITIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENEBODE	AVERAGE
B47419	108.0	178.3	-	50.3	356.3	127.3	164
B881104	160.7	91.7	-	42.0	235.3	146.0	135.1
B991114	112.0	181.7	-	20.3	111.0	157.3	116.5
BBZ921101	146.0	198.3	-	32.7	227.0	152.0	151.2
BBZ92653	206.7	245.0	-	50.3	126.3	116.0	148.9
BBZ951034	130.7	108.3	-	20.7	212.7	160.0	126.5
BD1354-17	187.0	165.0	-	30.7	241.3	154.0	155.6
BD1388-31	118.7	153.7	-	52.7	234.3	162.7	144.4
N27	137.7	171.7	-	37.0	226.3	126.0	139.7
SP81-3250	121.7	185.0	-	36.7	199.0	122.0	132.9
	**	**		*	**	Ns	
SE±	16.2	14.4		1.0	33.6	28.4	
CV	19.6	14.9		4.6	26.9	21.5	

Although, significant differences were observed for only Sunt location in single stalk weight (Table 4), the varieties generally showed high stalk weight in all environment. The values recorded at Ilorin were however higher while Agenebode recorded lowest values. Across location, B991114 and BD1388-31(hybrid) has the highest weight (1.5kg). The hybrid also had highest single stalk weight in Sunt where the varieties differed significantly. Stalk yield contribute positively to cane yield and selection for high yielding canes should target for indirectly for stalk weight (Ishaq et al 1998).

Table 4: Mean values of single stalk weight per plot (kg) for sugarcane clones evaluated at different locations in Nigeria

VARIETIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENBODE	AVERGE
B47419	0.7	1.4	-	2.7	1.2	0.6	1.3
B881104	1.3	1.5	-	2.4	1.2	0.4	1.4
B991114	0.9	1.3	-	3.6	1.5	0.2	1.5
BBZ921101	1.0	1.1	-	2.6	1.1	0.2	1.2
BBZ92653	0.8	1.1	-	2.4	1.5	0.2	1.2
BBZ951034	0.8	1.7	-	2.9	1.1	0.3	1.4
BD1354-17	0.9	1.3	-	2.3	1.3	0.4	1.2
BD1388-31	1.1	2.1	-	2.5	1.4	0.3	1.5
N27	1.0	1.6	-	2.6	1.1	0.2	1.3
SP81-3250	0.8	1.6	-	2.2	1.3	0.1	1.2
	ns	**	-	ns	ns	ns	
SE±	0.2	0.2		0.4	0.1	0.1	
CV	28.1	20.3		25.8	17.8	34.5	

Performance of the varieties for Field brix is shown on Table 5. Field brix which is also referred to as sugar yield was observed to be generally high for all the varieties in all locations. However significant differences were observed in Sunt, Bacita and Ikenne locations. The varieties also showed high brix values at locations in the forest areas (Ikenne and Agenebode) except B47419 with brix value of 14.9% at Ikenne. This shows that these varieties would have high sugar recovery even in the forest areas of the country with high rain fall. Such varieties can also be selected for cultivation in the southern parts of Nigeria. BBZ921101 however had the highest brix value across locations.

Table 5: Mean values of Brix (%) for sugarcane clones evaluated at different locations in Nigeria

VARIETIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENEBODE	AVERAGE
B47419	19.6	18.0	20.4	22.3	14.9	21.1	19.4
B881104	19.2	18.3	21.8	21.7	19.8	17.9	19.8
B991114	22.7	20.3	21.0	20.7	21.7	22.0	21.4
BBZ921101	21.0	22.7	24.5	22.0	22.4	22.5	22.5
BBZ92653	21.2	19.7	21.0	21.0	18.9	18.3	20.0
BBZ951034	20.7	20.7	22.8	21.3	22.1	21.7	21.6
BD1354-17	19.5	13.0	21.4	21.3	17.9	22.2	19.2
BD1388-31	18.5	18.0	21.0	20.7	17.2	19.7	19.2
N27	19.7	20.3	22.1	21.7	18.5	23.1	20.9
SP81-3250	21.1	19.7	22.3	20.0	21.3	21.0	20.9
		**	**		**		
SE±	0.5	1.0	0.4	0.6	0.6	1.7	
CV	4.2	8.8	3.5	4.9	4.9	13.7	

Mean values for cane yield in tonnes per hectare is shown on Table 6. Cane yield were generally high in all the locations except in Agenebode. Significant differences in yield were also observed in all the locations except in Ilorin and Agenebode. Highest cane yield was obtained in Badeggi location from BD1354-17 (122.8t/ha), an hybrid, although B47419 obtained the highest mean yield across all locations (93.6t/ha). B881104 recorded the lowest cane yield across the locations (37.5t/ha). High cane yield observed in most of the locations shows that the exotic varieties perform excellently in all locations and can be adapted to the different ecologies of Nigeria especially the southern part where sugarcane is not in commercial production.

Table 6: Mean values of cane yield (t/ha) for sugarcane clones evaluated at different locations in Nigeria

VARITIES	BADEGGI	SUNTI	BACITA	ILORIN	IKENNE	AGENEBODE	AVERAGE
B47419	55.9	99.6	90.7	120.7	145.6	49.0	93.6
B881104	104.8	54.5	102.5	98.7	74.6	37.5	78.8
B991114	84.9	100.9	71.1	93.1	87.9	51.4	81.6
BBZ921101	120.4	76.7	86.3	88.7	85.6	67.9	87.6
BBZ92653	108.7	95.8	82.9	103.8	80.1	54.5	87.7
BBZ951034	81.8	79.6	114.0	83.9	106.9	60.3	87.8
BD1354-17	122.8	91.2	78.9	111.1	86.2	50.3	90.1
BD1388-31	104.7	89.2	69.7	103.2	86.8	62.2	86
N27	114.9	103.9	71.1	80.8	85.8	38.7	82.5
SP81-3250	82.0	124.2	61.1	82.7	93.7	55.7	83.2
	**	**	***	ns	**	ns	
SE±	11.7	8.3	1.5	12.4	10.0	16.0	
CV	20.6	15.7	3.2	22.1	18.5	52.4	

Juice quality analysis was carried out only for Cane samples from Badeggi location and presented on Table 7. From the Table, varieties show similarity in Pol and Purity percentages, although with minor differences. There is greater difference between the varieties for Fibre, Recovery Sugar percentages and Sugar yield in ton/ha. Most of the Varieties have moderate fibre content except B881104 and B991114.

Recovery sugar percent and Sugar yield are the most important sugar quality parameter. It was observed that B991114, although low in fibre content, its highest in Recovery sucrose and also high in sugar yield. This variety would be suitable for selection for high sugar yield. BBZ921101, although has the highest fibre content, it also has the high sugar recovery percent and highest sugar yield. The variety can therefore be adopted for both high energy source or high sugar yield (dual purpose).

Table 7: Juice quality and sugar yield for sugarcane clones evaluated at different locations in Nigeria

Varieties	Fibre (%)	Purity (%)	Pol (%)	Recovery Sucrose (%)	Sugar Yield (ton/ha)
B47419	12.94	69.50	14.87	8.10	4.50
B881104	8.58	68.30	16.39	9.80	10.30
B991114	9.95	73.60	20.89	13.00	11.00
BBZ921101	14.97	83.70	19.25	12.10	14.70
BBZ92653	14.42	80.90	18.56	11.20	12.20
BBZ951034	10.57	77.20	19.30	12.09	9.90
BD1354-17	13.99	82.20	17.24	10.40	12.80
BD1388-31	10.37	69.10	10.63	4.30	4.50
N27	11.37	66.50	13.97	7.20	8.30
SP81-3250	12.30	74.10	17.03	9.70	8.80

Soils samples collected in all the locations were analysed and result presented on Table 8. Most of the soils are slightly acidic. The organic matter content is moderate for other most locations except Sunti and Ilorin. The Nitrogen content of all the locations where the trila is planted is observed to be low. Most of the soils are highly sandy especially Badeggi and moderate clay content. Ikenne location however has higher clay content in its soil. The silt content of all the locations is generally high especially Bacita and Ikenne locations. However the silt content of Badeggi soil is observed to be very low.

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BBZ921101	14.97	83.70	19.25	12.10	14.70
BBZ92653	14.42	80.90	18.56	11.20	12.20
BBZ951034	10.57	77.20	19.30	12.09	9.90
BD1354-17	13.99	82.20	17.24	10.40	12.80
BD1388-31	10.37	69.10	10.63	4.30	4.50
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Table 8: Soil analysis across the locations

LOCATION	pH	OM (%)	P (ppm)	N (%)	K cmol/kg	Sand (%)	Clay (%)	Silt (%)
SUNTI	5.45	0.31	17.17	0.04	0.67	93.52	5.20	1.28
ILORIN	6.46	0.58	29.14	0.03	0.26	93.52	5.20	1.28
BACITA	6.57	1.17	18.02	0.04	0.50	91.52	5.20	3.28
IKENNE	5.42	1.00	17.11	0.06	2.29	89.52	7.20	3.28
BADEGGI	6.13	1.5	11.33	0.14	0.42	95.68	3.76	0.56

Conclusion

The exotic varieties were observed to show good performance across all the locations in stalk characteristics and cane yield. The varieties also showed height performance in the forest zone where sugarcane is not cultivated in commercial quantity. The sugar analysis carried out in Badeggi also shows potential of the varieties for sugar yield. This shows that the exotic varieties can be easily adopted in the Nigeria ecology as they exhibited high adaptation. The variety BBZ921101, with high fibre content, sugar recovery percent and highest sugar yield be adopted for both high energy source or high sugar yield (dual purpose). The result obtained from this study can however be confirmed after two ratoon crops.

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